

018 Rec'd PCT/PTO 0.4 JAN 2002

TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER

THC.P.US0001

U.S. APPLICATION NO. (if known, see 37 CFR 1.5)

10/030405

INTERNATIONAL APPLICATION NO.
PCT/GB00/02563INTERNATIONAL FILING DATE
04 July 2000PRIORITY DATE CLAIMED
05 July 1999

TITLE OF INVENTION

ELECTROMAGNETIC RAMS

APPLICANT(S) FOR DO/EO/US

Phillip Raymond Michael DENNE

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
 - a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☐ has been transmitted by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
 - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☐ have been transmitted by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☐ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A **FIRST** preliminary amendment.
☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information:
Applicant is a Small Entity
Bibliographic Data Sheet
Copy of the International Preliminary Examination Report
with Annexes (4 pages of specification & 2 sheets of drawings)
Copy of Published International App No. PCT/GB00/02563 with
International Search Report
Check in the amount of \$445.00
Return Receipt Postcard

U.S. APPLICATION NO. (if known) 107030005		INTERNATIONAL APPLICATION NO. PCT/GB00/02563		ATTORNEY'S DOCKET NUMBER THC:P:US0001	
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17. ☒ The following fees are submitted:

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :

Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO **\$970.00**

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **\$840.00**

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO **\$690.00**

International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) **\$670.00**

International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) **\$96.00**

ENTER APPROPRIATE BASIC FEE AMOUNT =

CALCULATIONS PTO USE ONLY

JC13 Rec'd PCT/PTO 04 JAN 2002

Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				\$	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	\$	
Total claims	7 - 20 =	0	X \$18.00	\$	0
Independent claims	1 - 3 =	0	X \$78.00	\$	0
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ \$260.00	\$	
TOTAL OF ABOVE CALCULATIONS =				\$	890
Reduction of 1/2 for filing by small entity, if applicable. A Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28).				\$	445
SUBTOTAL =				\$	445
Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				\$	
TOTAL NATIONAL FEE =				\$	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property				\$	
TOTAL FEES ENCLOSED =				\$	445
				Amount to be refunded:	\$
				charged:	\$

a. ☒ A check in the amount of \$ 445.00 to cover the above fees is enclosed.

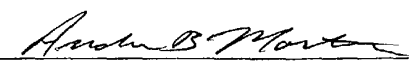
b. ☐ Please charge my Deposit Account No. _____ in the amount of \$ _____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 18-0987. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO

Andrew B. Morton, Esq.
Renner, Kenner, Greive, Bobak
Taylor & Weber
4 Floor, First National Tower
Akron, OH 44308



SIGNATURE

Andrew B. Morton

NAME

37,400

REGISTRATION NUMBER

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the application of

Phillip Raymond Michael DENNE

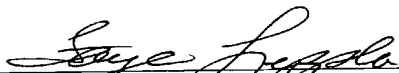
International App. No. PCT/GB00/02563

Internationally Filed 04 July 2000

For ELECTROMAGNETIC RAMS

**CERTIFICATE OF MAILING
VIA EXPRESS MAIL**

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)
) I hereby certify that this correspondence was
) deposited with the United States Postal Service as
) Express Mail, in an envelope addressed to: BOX
) PATENT APPLICATION, Assistant Commissioner for
) Patents, Washington, D.C. 20231, on January 4,
) 2002.

)
)
) 
) Faye Leppa, Secretary to Andrew B. Morton
) Express Mail Label No. EL725989960US

PRELIMINARY AMENDMENT

Box Patent Application

Assistant Commissioner for Patents

Washington, D.C. 20231

Sir:

The Applicant, through his attorney, requests the following amendments be entered prior to examination and prior to calculation of the fee.

In the claims:

Please replace the following claims. A marked-up of the claims is attached hereto.

5. (Amended) An actuator according to claim 2, wherein the ends of the cylinder are sealed and the slot 15 is provided with a sliding seal (16) in order to provide clamping for the movement of the first assembly in the second assembly.
6. (Amended) An actuator according to claim 2, wherein the said other assembly comprises a plurality of coils would in order to create a channel to receive the fin of the first assembly.

Please cancel claim 8 without prejudice or bias.

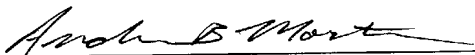
REMARKS

The amendments presented hereinabove have been made in order to eliminate multiple dependency of some of the claims as filed. A copy of the International Preliminary Examination Report, filed with this application, shows that these claims meet the novelty, inventive step and industrial applicability requirements of the Patent Cooperation Treaty. It is believed the claims as amended are patentability distinct over the prior art and, therefore, a Notice of Allowance of claims 1-7 is earnestly solicited.

No fee is believed due with the filing of this document, nonetheless, in the event that a fee is required for the filing of this document is missing or insufficient, the undersigned attorney hereby authorizes the Commissioner to charge payment of any fees associated with this communication or to credit any overpayment to deposit account 18-0987, designating file no. THC.P.US0001.

Should the Examiner care to discuss any of the foregoing in greater detail, the undersigned attorney would welcome a telephone call.

Respectfully Submitted,



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Attorney for Applicant

January 4, 2002

MARKED-UP VERSION OF THE CLAIMS
International App. No. PCT/GB00/02563

5. (Amended) An actuator according to [claims] claim 2, [3 or 4,] wherein the ends of the cylinder are sealed and the slot 15 is provided with a sliding seal (16) in order to provide clamping for the movement of the first assembly in the second assembly.
6. (Amended) An actuator according to [any one of claims 2 to 5,] claim 2, wherein the said other assembly comprises a plurality of coils would in order to create a channel to receive the fin of the first assembly.

Please cancel claim 8 without prejudice or bias.

Electromagnetic Rams

The present invention relates to electromagnetic rams.

Such rams are known and have various constructions but principally they are all variations of piston and cylinder devices with the output being coaxial with the centre line of the ram. This causes difficulty when used in a confined space as it means that for a full stroke, one requires twice the length of the stroke to be available or for a part of the ram to be received in a recess in the mounting. This difficulty has resulted in electro magnetic rams being limited in their uses.

The present invention provides an electromagnetic ram where a member extending transverse to the axial direction is used to transfer movement of the armature to the outside of the ram through an axially extending slot.

In one embodiment, the ram is in the form of a stator provided with coils which cooperate with the magnetic field produced by a magnetic assembly on the armature to produce motion when energised. This in turn requires the coils to be wound in such a manner as to form a gap through which the transverse member may move.

Preferably, each coil is wound as a pair of coil sections in an approximation to a "figure of 8" and the coils are connected in sets of three so as to be capable of being energised by signals which are out of phase with each other, for example by 120° , to form a three phase drive.

In another embodiment, the ram is in the form of a stator provided with a permanent magnet in order to create a fixed field of alternate magnetic poles, and an armature having one or more coils wound on a former.

In this embodiment, the coils are conventional coils but it does require the provision of a special connector to provide power to the coils eg in the form of a flexible bend.

Advantageously, the permanent magnets of the stator are provided with pole pieces in the form of slotted discs and the pole pieces are preferably shaped in order to provide a desired shaping of the magnetic field.

In order that the present invention be more readily understood, an embodiment thereof will now be described with reference to the accompanying drawings, in which,

Fig 1 is a sectional side view of a first embodiment of an
5 electromagnetic ram according to the present invention;

Fig 2 is an end view of the ram shown in Fig 1;

Fig 3 is a diagrammatic representation of a coil formed by a pair of
coil sections; and

Fig 4 is a diagrammatic side view of another embodiment of the
10 present invention.

Referring to Fig. 1, an electromagnetic ram comprises a cylindrical stator 11 formed from a steel outer tube within which is mounted an armature 12 for movement along the length of the stator 11.

The armature 12 is shorter than the stator 11 and is provided with a
15 transversely directed member 14 which can take any convenient form but in this case is shown as a fin 14 which is elongate in the axial direction. The fin 14 is received in an axially extending slot 15 provided in the wall of the stator 11.

The armature 12 is constructed from one or more assemblies of a
permanent magnet member 17 which is axially magnetised and sandwiched
20 between two pole pieces 18. If necessary, the pole pieces may be tapered towards their radial edges so as to reduce the field in the core and also the mass of the armature. It is also possible to insert a thin compliant disc between the pole pieces of adjacent magnetic assemblies. This will allow for manufacturing tolerances but also permits rams with long stators being formed which utilise an armature having
25 a number of magnetic assemblies.

Within the steel outer tube, the stator is provided with especially wound coils which leave a gap through which the member 14 may extend. As shown in Fig. 3, one way of achieving this is to wind each coil in the form of two coil portions in the form of a "Figure of 8". The coils are assembled in sets of three

(one pair of coil sections for each of three phases for each magnetic period). The current for each phase must alternate in direction hence the way in which the coils are wound without crossing the gap of the axially extending slot 15 in the stator. The magnetic assembly or assemblies project a strong magnetic field radially outwards through the coils of the stator; the magnetic flux returning via the outer steel tube that completes the assembly.

The interior of the stator 11 is preferably lined with a hard, slotted dielectric tube that serves as a bearing and seal surface. The armature 12 is provided with a bearing surface or surfaces e.g. in the form of piston rings which are arranged to slide along the hard dielectric tube.

Each assembly of a permanent magnet member 17 sandwiched between pole pieces 18 is preferably circular in axial cross-section. Because the armature 12 may be constructed from a number of assemblies it is possible to allow relative pivotal movement between each assembly or between groups of assemblies in any direction about the central axis. Thus, the armature, being carried on a series of bearing rings running on the stator lining tube which is made of a hard dielectric material, is able to follow irregularities, or even deliberate curvature, of the axis of the cylinder. This is a significant advantage if the ram is required to curve upwards or around an obstacle. It also provides tolerance to structural misalignments resulting from mechanical stress, temperature gradients or damage. While compliant discs between assemblies might be sufficient to provide the necessary amount of relative movement, other more complex coupling arrangements may be used depending upon the application. Further, the fin 14 may need to be articulated or the connection between the armature 12 and the fin 14 may need to be articulated.

With this basic electromagnetic construction, it is possible to form a number of different actuators. For example, if the stator is a closed cylinder eg sealed ends are provided to the tube shown in Fig 1, and the actuator is fitted with a circumferential seal and thus forms a piston, a rodless pneumatic actuator can be

formed when the interior is filled with a gas e.g. air which can be supplied from a fixed or variable pressure source. This in turn requires a sliding pressure seal 16 to be provided in the slot 15. Otherwise, the slot 15 need only have a protective seal against dirt and other contamination.

5 Also, the shape of the cylinder need not be constrained to be a circular cross section but may be elliptical so as to ensure that the fin 14 runs truly down the centre of the slot and can tolerate side forces.

 Further, the slotted stator may itself be curved and if curved to a uniform radius would allow the fin of the armature to move in an arc of a circle.
10 In this construction it may be essential to use compliant discs between each magnetic assembly in view of the fact that the armature slides against the lining tube provided on the stator. Consequently, if the fin 14 is replaced by or coupled to a radius arm, the arm could be connected to an orthogonal shaft so that the forces exerted on the armature exert a torque on that shaft. It will be understood
15 that by this means a high-torque may be directly produced with the minimum of moving parts. Further, if the arc is continued to a complete circle around the shaft in question, this allows the armature to be lengthened so as to fill the whole stator thus producing the maximum possible torque. The armature may then be caused to rotate continuously if required. This in turn forms a toroidal rotary motor which
20 could be used in the precise angular positioning of optical or other special equipment.

 Additionally, more than one ram can be utilised to effect movement of a single member. In other words, two or three rams could be mounted on either side of and connected to a common actuator member which in turn may have an
25 extension projecting out of a housing. The overall length of the system need be no longer than the length of one ram but the output will of course be a multiple of that of a single ram.

 The above embodiment is described as a ram having a permanent magnet armature and operating as a three phase synchronous machine. Other

constructions are possible such as one where the armature uses coils and the stator is formed with permanent magnets. Fig 4 shows diagrammatically one form of ram having such a construction. Here, the armature 12 is formed by a number of conventional coils 20 wound on a steel core 21, the coils being supplied with power by means of a trailing lead 22 of sufficient length to permit the armature to travel along the stator.

The stator 11 is formed by a number of permanent magnet section 24 poled to form alternating magnetic poles along the length of the stator 11. Each permanent magnet section 24 comprises a permanent magnet 24a and pole pieces 24b. It is preferred to shape the pole pieces 24b so that they appropriately shape the magnetic field. In this case, they taper uniformly towards the periphery of the permanent magnet of each section. This has the effect of decreasing the strong magnetic field around the outside of each section 24.

The sections 24 are each slotted and the slots are aligned so as to permit a transversely entering fin (not shown) attached to the armature 12 to be freely moved with the armature as in the first embodiment.

It is also possible to construct coils in order to form either the stator or armature as desired. In this technique when applied to a stator, the stator can be formed from a stack of planar iron rings separated from each other by cylindrical iron rings in order to form slots in a generally continuous iron cylinder. Each coil of copper is separately fitted into the slot between planar iron rings and appropriately energised to provide axially alternating magnetic poles. The iron structure could be replaced by a cast and/or metal component. Additionally, the stator may be designed to induce eddy currents in a passive armature so as to produce a low-cost machine suitable for opening doors or moving curtains.

One particular use of the ram as described is in an elevator where two or four slotted rams may be arranged against the inside walls of the elevator shaft, driving and guiding the cage silently, directly and precisely.

It will be appreciated that many uses of the actuator will require the

presence of a position detector in order to provide a feedback signal to a control unit in order to properly control the relative motion of the actuator by appropriate switching of the stator coils. This is not shown in the drawings but its location will depend to a large extent on the use to which the actuator is put and the actual construction of the actuator.

In the case of an elevator, the deadload of the cage and its payload is supported by gas within the stator. The exact value of this pressure is automatically adjusted by a small valve system and a small standby compressor. The gas pressure is controlled by a simple algorithm that integrates the value of the current supplied to the actuator in order to compensate for temperature changes, lenses, load changes and elevator parking arrangements. Since air is not consumed during elevator motion the compressor need not be of a large capacity.

With long stators such as are envisaged with elevators, the stator coils should be divided into relatively short sections. This permits only those sections of the stator coil assembly adjacent the armature to be energised and switched thus improving power efficiency.

CLAIMS:

1. An electromagnetic actuator comprising a first magnetic assembly, a second magnetic assembly, the polarity of one of said assemblies being changeable
5 in response to an electrical control signal in order to cause relative movement between the first and second assemblies along an axis of relative movement, one of the assemblies (12) being provided with a fin (14) projecting transversely to said axis of relative movement and the other of the assemblies being provided with a slot (15) extending parallel to the axis of relative movement and arranged to
10 receive the fin (14), characterised in that the said other assembly comprises a plurality of magnetic elements in order to create axially alternating magnetic fields.
2. An actuator according to claim 1, wherein said other assembly is in
15 the form of a cylinder arranged to house the first assembly.
3. An actuator according to claim 2, wherein the second assembly comprises a plurality of permanent magnetic sections each having pole pieces (24b).
20
4. An actuator according to claim 3, wherein the pole pieces (24b) taper towards the outer periphery of the assembly.
5. An actuator according to claims 2,3 or 4, wherein the ends of the
25 cylinder are sealed and the slot 15 is provided with a sliding seal (16) in order to provide clamping for the movement of the first assembly in the second assembly.
6. An actuator according to any one of claims 2 to 5, wherein the said other assembly comprises a plurality of coils wound in order to create a channel to

receive the fin of the first assembly.

7. An actuator according to claim 6, wherein the coils are wound in pairs in a figure of eight.

ABSTRACT

An electromagnetic ram in the form of a cylindrical magnetic assembly (11) arranged to receive a cooperating armature (12) for movement along the length of the cylinder. The armature (12) is provided with a transversely extending member (14) for transferring movement of the armature to the outside of the ram through an axially extending slot (15) in the cylinder (11).

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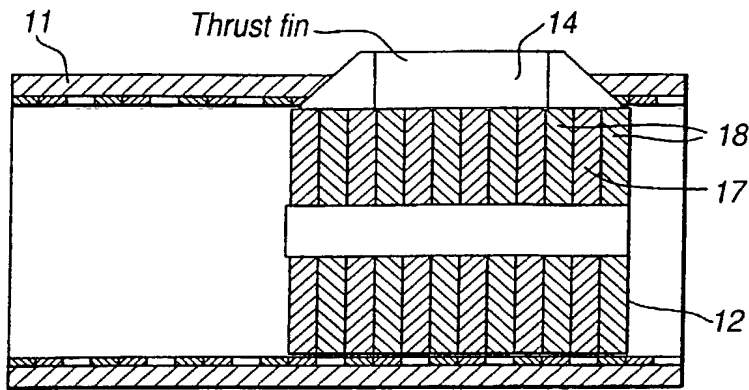


Fig. 1

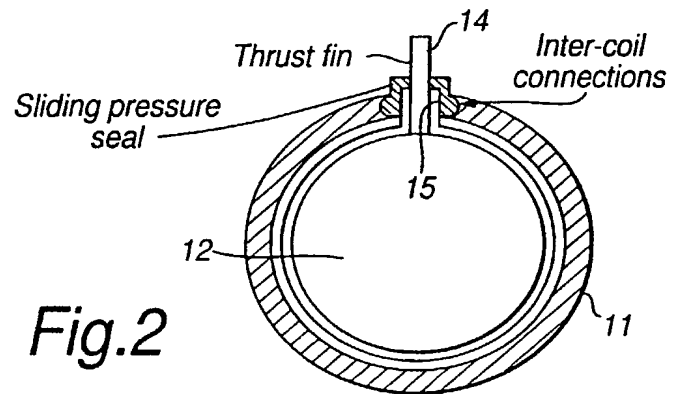


Fig. 2

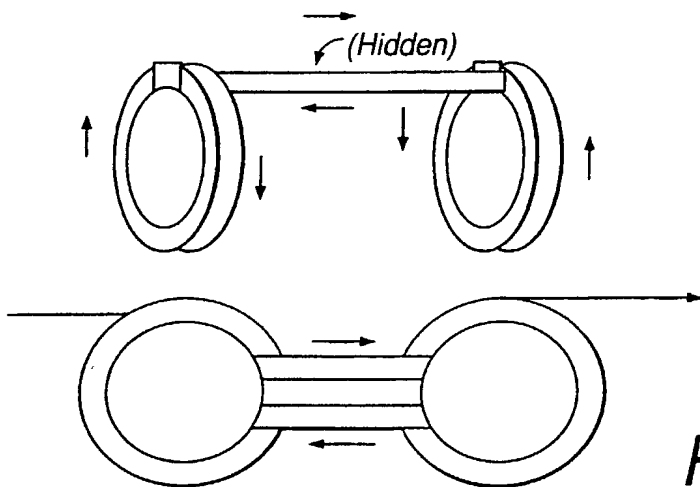


Fig. 3

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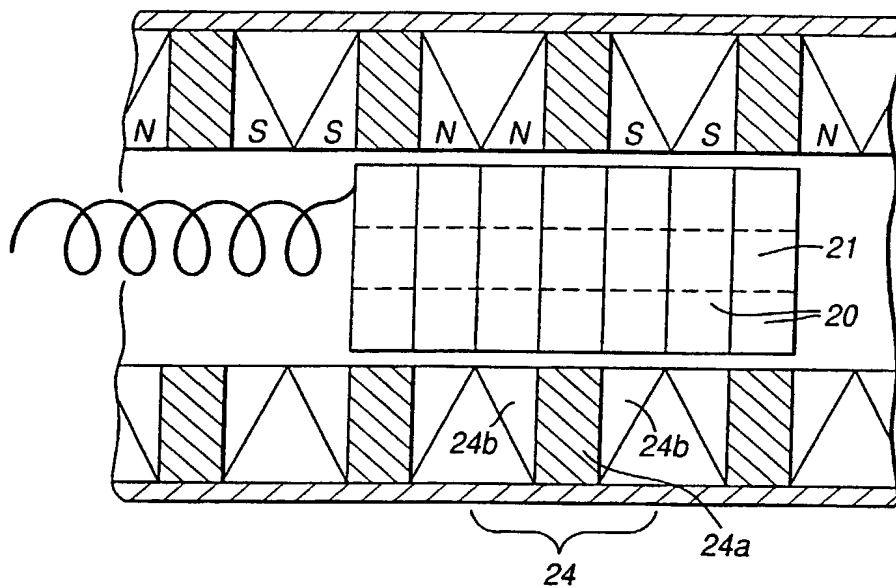


Fig.4

#5

Attorney Docket No. THC.P.US0001

PATENT

COMBINED DECLARATION AND POWER OF ATTORNEY

As the below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled

ELECTROMAGNETIC RAMS

the specification of which

_____ is attached hereto.

 X was filed on 4 July 2000 as Application Serial No. PCT/GB00/02563 and was amended on 1 October 2001.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

			<u>Priority Claimed</u>	
99 15708.3	Great Britain	5 July 1999	X	
Number	Country	Date Filed	Yes	No
PCT/GB00/02563	PCT	4 July 2000	X	
Number	Country	Date Filed	Yes	No

English Language Declaration

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

<u>PCT/GB00/02563</u>	<u>4 July 2000</u>	<u>Pending</u>
Application Ser. No.	Filing Date	Status

Application Ser. No.	Filing Date	Status
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POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith:

(15) Reese Taylor (Reg. No. 22,325); Phillip L. Kenner (Reg. No. 22,353); Edward G. Greive (Reg. No. 24,726); Donald J. Bobak (Reg. No. 27,182); Ray L. Weber (Reg. No. 26,519); Joseph G. Curatolo (Reg. No. 28,837); Rodney L. Skoglund (Reg. No. 36,010); Andrew B. Morton (Reg. No. 37,400); Arthur M. Reginelli (Reg. No. 40,139); Salvatore A. Sidoti (Reg. No. 43,921); John J. Cunniff (Reg. No. 42,451); Shannon McCue, Reg. No. 42,859; Mark Weber (Reg. No. 46,069); James E. Oehlenschlager, Reg. No. P50,164; and Tama L. Drenski, Reg. No. P50,323.

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Telephone: (330) 376-1242

DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereof.

SIGNATURE

1-00
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P. R. M. Denne
Phillip Raymond Michael DENNE

Date 21 February 2002.

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